motion as they are not secured to the hammer housing.

It should be appreciated that while drop hammer devices are not designed to be used in a raking motion, they can be operated at angles substantially away from the vertical plane. This freedom of movement away from the vertical allows drop hammer devices to be used to break uneven portions of concrete, and low lying walls or the like and extends the number of places a drop hammer device can be utilised.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the listed components it directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from

the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a method of securing a shaft at any point along its substantially vertical axis of movement, including a locking device,

wherein the locking device has at least one face that is moveable with respect to the shaft, the method characterised by the step of

a) moving the locking device into a position wherein at least one face of the locking device mates against at least one point on the shaft so as to secure the shaft at any point along its substantially vertical axis of movement.

The term 'shaft' in accordance with the present invention should be understood to mean an elongated block or pole that can be moved along a substantially vertical axis. It should be appreciated that the axis can be angled up to approximately 89° either side of vertical as desired. However, this angling of the shaft can only be achieved when the shaft and its housing are moved as a single unit. The shaft itself has some freedom of movement within its housing, but only sufficient to allow for normal activity, as known to someone skilled in the art.

In preferred embodiments the shaft is an elongated block that is formed into a hammer, the hammer being an elongated piece of heavy material designed to be pounded into an area to result in failure of the material underneath, be it concrete, building material, rock, ground, or the like. However, these are listed by way of example only and should not be seen to be limiting.

For ease of reference, the shaft shall now be referred to as a hammer throughout

the specification however this should not be seen to be limiting.

It should be appreciated that the hammer can be enclosed within a housing, the housing including a mechanism configured to lift the hammer to a raised position. Once the hammer is in the raised position it can be released and due to the weight of the hammer, gravity will accelerate the hammer into the area beneath the hammer, imparting a large impact force and breaking or weakening whatever is situated beneath the impact zone.

It should further be appreciated that the hammer could be in the shape of a cylinder or an elongated box with multiple faces, or variation thereof as these are listed by way of example only and should not be seen to be limiting.

In preferred embodiments the hammer is an elongated vertical column with multiple faces.

It should be appreciated that the hammer does not normally include any internal attaching means to secure the hammer to the hammer housing, instead the hammer is held in place by the hammer housing, but it is not usually physically attached to it. Upon activation, the raising of the hammer can be undertaken by any number of mechanisms that impart lift. The mechanisms used to lift the hammer into position are known to someone skilled in the art and can include a cable attached to the upper end of the hammer or a chain and dog arrangement that engages a protrusion that extends from the hammer itself, however these are listed by way of example only.

The term 'dog' in accordance with the present invention should be understood to mean a catch physically attached to the chain that protrudes outwards, and will engage any protrusion extending from the drop hammer. The term 'dog' is known to someone skilled in the art, but should not be seen to be limiting.

The term 'protrusion' in accordance with the present invention should be understood to mean at least one extension of a portion of the drop hammer out to the side of the drop hammer so it is available to be engaged by the dog.

Once engaged, the upward movement of the chain will lift the dog and the drop hammer along with it.

It should be appreciated that there can be more than one protrusion which can be positioned on any vertical side of the drop hammer.

In preferred embodiments, the mechanism used to lift the hammer into its peak vertical position is the chain and dog arrangement. The chain rotates around at least two sprockets positioned lengthwise to the drop hammer. The chain has at least one dog attached to it that engages the protrusion, or protrusions positioned on the hammer. As the chain is rotated, the hammer will lift as the dog attached to the chain rises. As the hammer reaches its maximum vertical height, the dog attached to the chain rotates around the sprocket and the hammer is released as the protrusion is positioned to the side of the sprocket.

It should be appreciated that any locking device could be positioned to abut against any point anywhere on the hammer.

It should also be appreciated that the vertically rotating chain could either be parallel with or perpendicular to the hammer. Accordingly, any locking device could be positioned between the rotating chain, as the chain would, in preferred embodiments, be oriented parallel to the hammer, rather than perpendicular to it in order to reduce the overall size of the hammer housing and therefore the overall weight of the unit as a whole.

The term 'locking device' in accordance with the present invention should be understood to mean a friction-based lock such as a cam, magnet or any locking

means that utilises the onset of friction between two faces as they mate together to lock an item into a position, although these are listed by way of example only and should not be seen to be limiting.

By using a friction based locking device, the likelihood of damage to the locking device or the mechanism around it is reduced. If a pin based locking device where a pin enters a recess were used, the likelihood of the pin shearing over time due to impact wear would be higher. If the locking device was activated while the hammer was moving, any pin based locking device would more than likely be sheared off due to the downward force of the hammer. The use of a friction based locking device would mean that even if the lock were activated while the hammer was falling, the friction created by the two faces meeting would only serve to slow the hammer down and lock it into place, not shear the cam off it's rotational axis, although it is not envisaged that the lock would be engaged while the hammer is in vertical fall.

It is an advantage of a friction-based lock that there is a reduced likelihood of damage to the lock due to shearing or the like.

The term 'cam' is a term known to someone skilled in the art and refers to a substantially flat projection on a rotating part in machinery.

In preferred embodiments the locking means is a cam configured so that on activation the cam will rotate and the substantially flat face will turn and meet, or mate with the face of the hammer at whatever position the hammer is in.

Cams are versatile and will allow slip between the two 'mating' faces should the force applied to the hammer overcome the strength of the lock. This slip therefore reduces the likelihood of destruction of the locking means in unusual circumstances.

It should also be appreciated that cams can be self tightening. As the rotation of the

cam is in a clockwise direction to bring the substantially flat face up against the hammer, any upward pressure of the hammer against the cam face will only serve to tighten the lock.

It is also an advantage of this type of locking means that the hammer can be secured at any height. The length of protrusion of the hammer out of the hammer housing can therefore be varied as desired by the excavator operator.

This is a distinct advantage over any locking mechanism that uses a pin and recess arrangement. Either recesses must be positioned at multiple points along the hammer, or there limited locking positions available. A friction based locking means can be activated at any point along the length of the hammer.

If the operator is using the hammer to break material, the hammer itself can be secured with any desired portion of the hammer extending out of the hammer housing. If the broken material is of a thicker nature, a larger portion of the hammer can be set to protrude from the hammer housing. The material can then be raked or moved in the horizontal motion to one side so that other machines can work alongside the hammer mechanism to remove the material.

This has a distinct advantage over the prior art as it allows both hammer and removal machines to work concurrently rather than consecutively. This has key advantages in reducing the costs to undertake a job as the time to complete the job is faster.

Another advantage of the present invention is that the addition of a locking mechanism allows a single machine to do the job of two machines. Both hammering and raking can be undertaken by the same machine, saving time and money and potentially increasing the safety of a worksite due to less heavy machinery working in a demolition site.

The ability to lock the hammer at any desired protrusion length is a further advantage in that the hammer length can be set to provide the operator with maximum visibility, therefore increasing operator comfort. The operator can also lock the hammer at any length, making the job effectively easier as there is less likelihood of damaging the hammer through incorrect usage.

The ability to lock the hammer in any desired position along its vertical axis is a distinct advantage over any standard drop hammer device as the drop hammer is usually not attached to any hammer housing. As such, any pressure applied to the hammer will push it back up into the housing, making raking or sweeping of material impossible.

In other embodiments, the locking means could be a mating face with a negative gradient that abuts a specially configured mating face on the hammer with a positive gradient. When the mating face of the locking means is rotated to abut the hammer the hammer is locked in place.

The direction of the slope of each mating face is important as if the hammer receives a knock, the locking means will tighten rather than release.

According to another aspect of the present invention there is provided a locking device for reversibly locking a hammer at any point along its substantially vertical axis of movement

wherein the locking means has a mating face, that once activated, will position itself against the mating face of the hammer to secure it in position.

The term 'mating face' in accordance with the present invention should be understood to mean the substantially flat surface of one portion of the locking means as one half of the pair of mating faces, and the substantially flat surface of the vertical portion of the hammer.

While the locking means utilises friction in order to secure the hammer in place, the pressure provided to the mating faces to increase friction to initiate locking can be undertaken by a number of means.

In preferred embodiments, a cam is used as the locking means. The rotation of the cam can be controlled by a hydraulic system.

The advantage of controlling the movement of the cam by hydraulics is that the hydraulics controlling the main housing can be tapped into to provide the further controlling means for the cam, therefore simplifying the addition of the locking device to drop hammer devices already in use.

Another advantage of using hydraulics to control the cam is that the abutment of the mating faces is by pressure, the preferred outcome of hydraulic application.

It is envisaged that when the hammer is being used as originally intended; moving through a substantially vertical trajectory, the locking means will remain in the unlocked position with the hydraulic controls in the off position. This will keep the two mating faces separate from each other and allow the hammer to fulfil its job.

It should be appreciated that it would be virtually impossible to lock the hammer in place while the hammer is operating as the hydraulic controls that activate the cam lock also activate the hammer itself. For one to work the other must be non-operational, therefore making it physically impossible to work the lift and lock mechanism at the same time, which reduces the likelihood of unintentional damage to the machine.

It should however be appreciated that the hammer could be used at any angle away from the vertical, provided there is sufficient force provided by gravity or some other propulsion means.

When the control means in the cab of the carrier is activated, therefore engaging either a forward or sideways motion to the carrier and therefore the hammer itself, the hydraulic mechanism will be activated, the cam rotated and the hammer locked in place.

Accordingly, whatever position the hammer is in with respect to the hammer housing at the time of activation of the cam, the hammer will be locked into that position.

It should therefore be appreciated that the height of the hammer can be easily varied by pausing the vertical lift of the hammer housing and activating the cam.

It should also be appreciated that the hammer could be rested on the ground and the hammer housing moved with respect to it to push the hammer into the housing to the desired distance.

It is an advantage of the present invention that the drop hammer device itself has, by the addition of a lock, become a complete tool for both the breaking and moving of material. The end of the hammer is not only used for its impact, but also to rake material away from the work zone.

It is the inventor's opinion that a locking means designed to secure a hammer in a desired position to allow a raking or pushing movement has never been undertaken before. The combination of the locking means with the hammer means that a job undertaken by a drop hammer device can be completed in shorter time because not only can broken material be dragged to one side, but a larger partially broken piece could also be positioned for a second impact, making the job of the assisting machinery easier.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following

description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of a preferred embodiment of the present invention; and

Figure 2 is a diagrammatic representation of a preferred embodiment of the present invention showing a cam as the locking device, and

Figure 3 is a close-up of the diagrammatic representation of one preferred embodiment of the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

With reference to figure 1, there is illustrated a hammer (1), encased within a hammer housing (2) which is attached to a hydraulic excavator generally indicated by arrow 3.

Also illustrated in figure 1 is the hydraulic activation means (4) for use to engage the locking device (not shown in this figure).

With respect to figure 2 there is shown a close-up of a drop hammer device generally indicated by arrow 5. The drop hammer device 5 consists of a hammer (6), a raising mechanism generally indicated by arrow 7 in the form of a rotating chain (8), two end sprockets (9 a and b), a protrusion (10), a cam lock (11), a hydraulic activating means (12) and a hammer housing (2).

With respect to figure 3, there is shown a close-up of the cam lock (11) and the hydraulic activating means (12). Also shown are the rotating chain lower sprocket (9b), the protrusion (10), the hammer (6) and the hammer housing (2).

When the hammer (6) is operating, the rotating chain (8) containing at least one dog

(not shown) rotates.

The dog abuts the protrusion (10) situated on the side of the hammer perpendicular to the rotating chain (8).

As the chain (8) rotates, the dog rises, lifting the protrusion (10) which in turn raises the hammer (6).

When the protrusion (10) rises to a point level with the upper sprocket (9a), the dog rotates over the top of the upper sprocket (9a) and releases the protrusion (10), allowing the hammer to fall.

When the hammer (6) has completed its fall, the dog will rotate around the chain (8) and then abut the protrusion (10) and repeat the vertical lift.

In order to lock the hammer (6) in any position along it's trajectory, the cam (11) is rotated around its axis (13) by means of an actuator (14) which is controlled by the hydraulic activating means (12).

The actuator (14) is made up of two parts that pivot at the joint (15). The forward motion of the actuator (14) combined with the pivoting of the actuator at it's joint (15) allow the cam (11) to rotate to engage the hammer (1). This means that the hammer can be engaged at any point along its trajectory.

Once the hammer (6) is locked in a position by the cam (11) it can then be used at any angle, rather than just vertical, to rake material or position material for further impacting.

The operator can initiate the engagement of the cam (11) by activation of the hydraulic activating means (12) from inside the hydraulic excavator.

It should also be appreciated that the initiating of the cam (11) will either disengage

or halt the raising mechanism (7), or push the hammer (6) away from the raising mechanism (7) and up against the far side of the hammer housing (12) so that the catch mechanism cannot engage the protrusion (10) and raise the hammer (1).

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

CLAIMS:

1. A method of securing a shaft at any point along its substantially vertical axis of movement, said shaft including a locking device,

wherein the locking device has at least one face that is moveable with respect to the shaft, the method characterised by the step of

a) moving the locking device into a position wherein at least one face of the locking device mates against at least one point on the shaft so as to secure the shaft at any point along its substantially vertical axis of movement.

2. A method as claimed in claim 1 wherein the shaft is an elongated block.

3. A method as claimed in either claim 1 or claim 2 wherein the shaft is a hammer.

4. A method as claimed in claim 3 wherein the hammer is an elongated vertical column with multiple faces.

5. A method as claimed in either claim 4 or claim 5 wherein the locking device is adapted to abut the hammer

6. A method as claimed in any one of the previous claims wherein the locking device is a friction based lock.

7. A method as claimed in any one of the previous claims wherein the locking device is a cam

8. A method as claimed in claim 7 wherein the cam includes at least one substantially flat face.

9. A method as claimed in claim 8 wherein a substantially flat face of the cam is adapted to mate with a face of the hammer.

10. A method as claimed in any one of claims 7 to 9 wherein said at least one cam is adapted to rotate

11. A method as claimed in claim 10 wherein said at least one cam is adapted to rotate in a clockwise direction.

12. A method as claimed in any one of claims 7 to 11 wherein said at least one cam is able to abut the hammer at any position along the length of said hammer.

13. A method as claimed in any one of the previous claims wherein the locking device is adapted to be controlled by a hydraulic system.

14. A method as claimed in any one of the previous claims wherein the hammer is substantially enclosed within a housing.

15. A method as claimed in claim 14 wherein the housing includes a mechanism adapted to lift the hammer to a raised position.

16. A method as claimed in any one of the previous claims wherein the hammer includes at least one protrusion

17. A method as claimed in 16 wherein the protrusion is configured to be engaged by a mechanism adapted to provide lift to the hammer.

18. A method as claimed in any one of claims 15 to 17 wherein the mechanism configured to lift the hammer to a raised position includes at least two sprockets, at least one dog and a chain.

19. A method as claimed in claim 18 wherein at least one dog is attached to a

chain.

20. A method as claimed in either claim 18 or claim 19 wherein at least one dog is adapted to engage the protrusion.

21. A method as claimed in claims 18 to 20 wherein said at least one chain is adapted to be rotated around the sprockets.

22. A method as claimed in any one of claims 18 to 21 wherein at least two sprockets, at least one dog and at least one chain are positioned substantially parallel to the hammer.

23. A method as claimed in any one of claims 18 to 21 wherein the sprockets, dog and chain are positioned substantially perpendicular to the hammer.

24. A locking device for reversibly locking a shaft at any point along its substantially vertical axis of movement

wherein the locking device has a mating face, that once activated, will position itself against the mating face of the shaft to secure it in position.

25. A locking device as claimed in claim 24 wherein the shaft is an elongated block.

26. A locking device as claimed in either claim 24 or claim 25 wherein the shaft is a hammer.

27. A locking device as claimed in claim 26 wherein the hammer is an elongated vertical column with multiple faces.

28. A locking device as claimed in either claim 26 or claim 27 wherein the locking device is adapted to abut the hammer

29. A locking device as claimed in any one of claims 24 to 28 wherein the locking device is a friction based lock.

30. A locking device as claimed in any one of claims 24 to 29 wherein the locking device is a cam

31. A locking device as claimed in claim 30 wherein the cam includes at least one substantially flat face.

32. A locking device as claimed in claim 31 wherein a substantially flat face of the cam is adapted to mate with a face of the hammer.

33. A locking device as claimed in any one of claims 30 to 32 wherein said at least one cam is adapted to rotate

34. A locking device as claimed in claim 33 wherein said at least one cam is adapted to rotate in a clockwise direction.

35. A locking device as claimed in any one of claims 30 to 34 wherein said at least one cam is able to abut the hammer at any position along the length of said hammer.

36. A locking device as claimed in any one of claims 24 to 35 wherein the locking device is adapted to be controlled by a hydraulic system.

37. A locking device as claimed in any one of claims 24 to 26 wherein the hammer is substantially enclosed within a housing.

38. A locking device as claimed in claim 37 wherein the housing includes a mechanism adapted to lift the hammer to a raised position.

39. A locking device as claimed in any one of claims 24 to 38 wherein the hammer includes at least one protrusion

40. A locking device as claimed in 39 wherein the protrusion is configured to be engaged by a mechanism adapted to provide lift to the hammer.

41. A locking device as claimed in any one of claims 37 to 40 wherein the mechanism configured to lift the hammer to a raised position includes at least two sprockets, at least one dog and a chain.

42. A locking device as claimed in claim 41 wherein at least one dog is attached to a chain.

43. A locking device as claimed in either claim 41 or claim 42 wherein at least one dog is adapted to engage the protrusion.

44. A locking device as claimed in claims 41 to 43 wherein said at least one chain is adapted to be rotated around the sprockets.

45. A locking device as claimed in any one of claims 42 to 44 wherein at least two sprockets, at least one dog and at least one chain are positioned substantially parallel to the hammer.

46. A locking device as claimed in any one of claims 42 to 45 wherein the sprockets, dog and chain are positioned substantially perpendicular to the hammer.

47. A method of use of a locking device, substantially as herein described and with reference to figure 1.

48. A locking device substantially as herein described and with reference to figures 2 and 3.